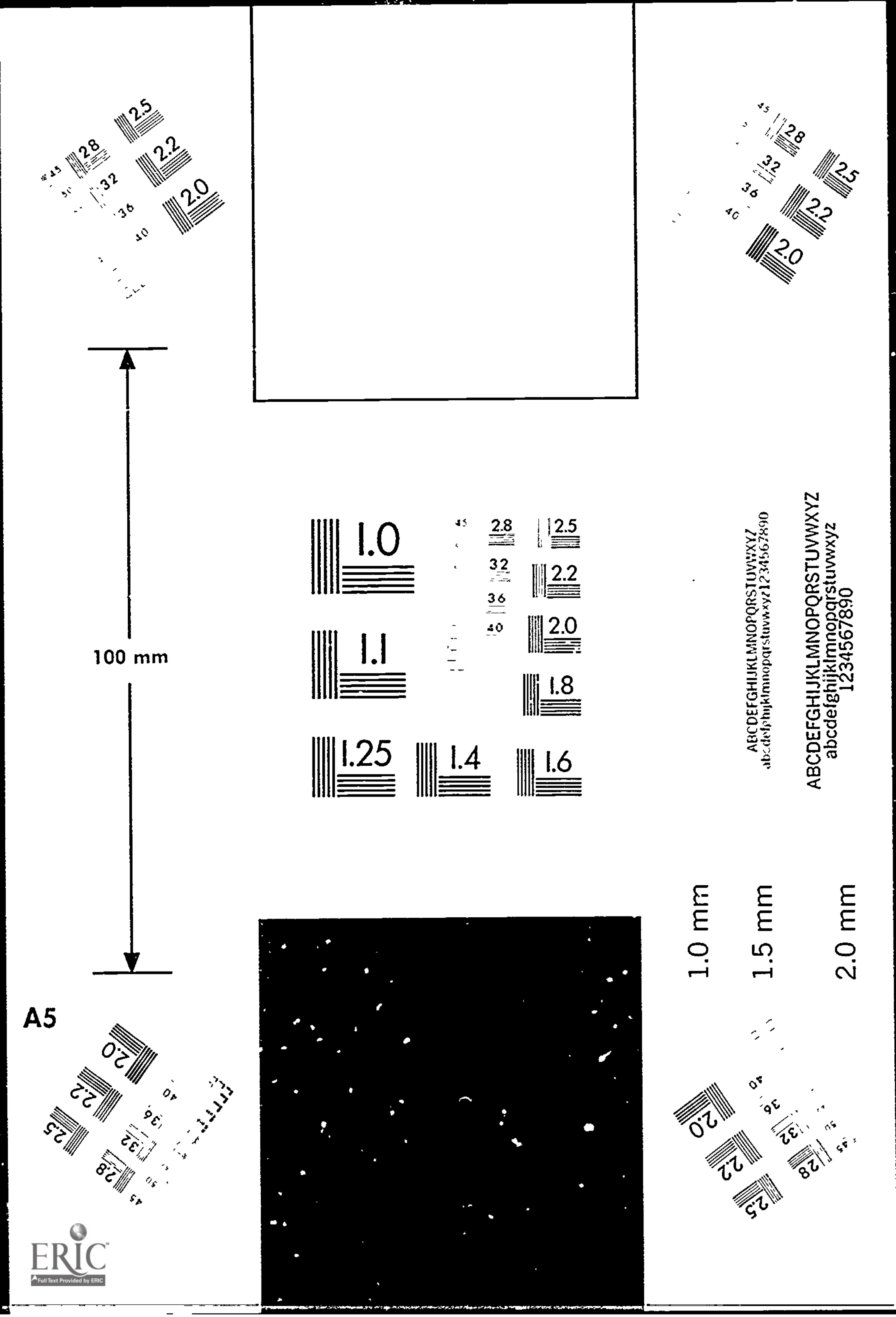
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ABSTRACT

One challenge in today's society is to teach students how to solve problems and use the general education they acquire to arrive at realistic solutions. Techniques that cut across the curriculum and can be used by any university teacher to provide realistic experiences for students are discussed. Students need the same acquired skills in technology and industry as are necessary for success in any professional field: communication and interpersonal skills, linked to problem solving skills. The techniques are clustered into the general categories of group dynamics (such as leadership, communication, presentation, and persuasion skills) and problem solving strategies (such as the design process, information management, and learning skills). An example of a process guide to problem solving, borrowed from technology, is described. Its seven steps are: define the problem carefully; establish criteria for the solution; research possible solutions; brainstorm all manner of sensible and nonsensible potential solutions; narrow the acceptable or promising options and develop them; create a working model; and evaluate the end result. The role of the educator should be to provide the student with appropriate experiences for defining and solving problems. Contains 5 references. (SM)

Problem Solving in a Technological Society with Implications for University Teaching Improvement

Paper Presented at the
15th International Conference on
IMPROVING UNIVERSITY TEACHING
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PROBLEM SOLVING IN A TECHNOLOGICAL SOCIETY WITH IMPLICATIONS FOR UNIVERSITY TEACHING IMPROVEMENT

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ABSTRACT

The ever changing nature of technology in our society provides educators with a myriad of challenges and problems for the curriculum. One such challenge is to teach students how to problem solve and utilize the general education they acquire to arrive at realistic solutions. The technique that will be discussed cuts across the curriculum and can be used by any university teacher to provide realistic experiences for students. Problems found in our modern technological society serve as the vehicle for this teaching technique and provide students with an opportunity to apply their general education to the solution of practical problems. The problem solving approach discussed consists of two major elements; group dynamics, whereby students learn about leadership, communication, presentation, and persuasion skills *and* problem solving strategies which include the design process, information management, and learning skills. Problem solving in the curriculum can place the same demands on students as they will experience in their professional careers. To bring an idea to fruition, to define it carefully and completely, to refine, communicate and defend that idea, and to compromise, are tasks not often asked of a student. This teaching strategy should help fill the void.

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The ever changing nature of technology in our society provides educators with a myriad of challenges and problems for the curriculum. This, compounded with the trend towards life-long learning, and the need for students who can function in a modern technological society, will provide educators at the university level, with innumerable opportunities for changing the curriculum and integrating realistic problem solving techniques into the teaching environment.

Addressing the issue of technological change and the need for educators to teach problem solving, the Commission on Pre-College Education in Mathematics, Science and Technology (National Science Board, 1983) noted the effects of technological changes in its report, Educating Americans for the 21st Century:

> We Must return to basics, but the basics of the 21st century are not only reading, writing, and arithmetic. They include communication and higher problem solving skills, and scientific and technological literacy---the thinking tools that allow us to understand the technological world around us... Development of students' capacities for problem solving and critical thinking in all areas of learning is presented as a fundamental goal (p.v.).

The commission's report indicates that society has undergone significant change. Many of these changes and problems facing society have come about because of the advancing technology. Robert Ornstein of the Institute for the Study of Human Knowledge wrote:

> Solutions to the significant problems facing modern society demand a widespread, qualitative improvement in thinking and understanding. We are slowly and painfully becoming aware that such diverse contemporary challenges as energy, population, the environment, employment, health, psychological well-being of individuals and meaningful education of our youth are not being met by the mere accumulation of more data or expenditure of more time, energy, or money... We need a breakthrough in the quality of thinking employed both by decision-makers at all levels of society, and by each of us in our daily affair. (Costa, 1985, p.4)

Society is in desperate need of individuals capable of finding viable solutions to a variety of challenges. These needs have prompted many leaders to suggest that education now implement methods of teaching that can enhance the problem solving ability of students (Hatch, 1988). According to Costa (1986), however, "most teachers do not regularly employ methods that encourage and develop thinking in their students" (p.5). Therefore, we as educators and especially those concerned with the teaching of teachers, have an opportunity to fill a void in the general education of students. The purpose of this paper is to provide practical suggestions on how a technological problem solving environment can be created and used by educators to help prepare students for living in our modern society.

The study of humanities and the social sciences plays a crucial role in the preparation of students for living. Areas such as philosophy are equally important, in that combined with math, science and technology they can supply students with the necessary perspective for quality thinking and application of technology to the real world.

If students can be placed in a problem solving role as they study ethics, sociology or history, for example, they can learn to grapple with very real

problems under the guidance of an experienced professional. Problem solving techniques can help them in the systematic delimitation of the problem, listing possible solutions, analyzing the effect of potential solutions and in logically selecting an appropriate final solution.

Problem solving as a teaching method:
Students need the same acquired skills in technology and industry as are necessary for success in any professional field: communication and interpersonal skills, linked to problem solving skills.

In today's industry, a designer or management professional will be working on a project group or product team with a directive to find the best solution to a critical question. No longer can any one person be expected to master a body of knowledge, with available information doubling every six years. As an example, an industrial designer in the 50's might have needed to be expert in mechanical design, steel fabrication and hydraulics. Today, the list could easily include digital controls, computer interfaces, data communication protocol, light and pressure sensors, radio frequency interference, and more. It should also include ethics, philosophy, social sciences, and the ability to grasp the interrelation of these types of disciplines with technology. Not even the most gifted engineer can be expected to know enough about all of these fields to develop an adequate design by today's standards. But a group who's concerted expertise covers this list could succeed, assuming that they could work together smoothly and draw on each member's strengths.

These latter cooperative skills are now being addressed by technology education. However, they are not unique to technology. Rather, they are broad based and may be applied to many endeavors in a university and an increasingly complex technological society. We can cluster these techniques into two general categories: group dynamics and problem solving strategies.

Group dynamics includes leadership, communication, presentation, and persuasion skills. These skills are vital in business or academia, in industry or politics, from committee work to designing. We teach them by compelling the students to use them. If a group of students will be evaluated on a final cooperative product, and no one member can manage all the work, persuasion and communication will develop. The group must find ways to organize and communicate internally and externally to accomplish a common goal.

The second category, problem solving strategies, includes the design process, information management, and learning skills. Creativity is not as difficult to organize as might be imagined. The following is an example of a process guide to problem solving that is borrowed from technology. This process works for a single person or a group, and for disciplines as divergent as the sciences, business and education.

1) Define the problem carefully and completely. Everyone involved in a challenging project needs to understand the problem in order to avoid counter productive or divergent goals. Any time s , spent will doubly save time in later stages. Additionally, many problems in our society are solved simply by being successfully identified and isolated.

2) Establish criteria for a solution. All those involved must set and agree to realistic goals, limitations, and expected or possible consequences. Be careful to allow for future adaptations that may become necessary, but are not immediately apparent. Also, on a practical note, agree to a schedule for the completion of the process steps. All this will set up the evaluation phase to come later.

3) Research possible solutions. Information management is necessary to avoid re-inventing the wheel. Has this problem been solved before? Are there lessons to be learned from other's mistakes? Where can information on similar topics be found?

4) Brainstorm all manner of sensible and seemingly non-sensible potential solutions. Make this a right-brain activity with as much latitude and as few rules as possible. At this point the ideas do not have to closely match the criteria. Quantity of ideas is better than quality. Specify a group member to record as quickly as possible the widest variety of ideas without judging them. Any evaluation is left to the next step.

5) Narrow the acceptable or promising options and develop them. Sketchy, brainstormed ideas need to be expanded before they can be completely evaluated. This process can be done by individuals or subgroups of two or three students who see potential in one of the ideas. Presentation and persuasion skills are fostered by having those subgroups favoring specific solutions compete, and be evaluated by the whole group, or the teacher acting as manager. Communication here becomes more than an exercise in that it is an opportunity for the student to persuade others to a personally held point of view, or to avoid having to adapt to the point of view of another. In our experience, the opportunity tends to be taken rather seriously. Students should be made aware of the fact that the better presentation has every bit as good a chance of prevailing as the better idea. Finally, one solution is agreed upon by the group.

6) Create a working model. In a typical problem solving exercise, we assign project leaders within the teams with responsibility to organize the effort. Decisions are made outlining individual responsibilities, and the manner in which the individual parts will fit together. Procedures must be in place to handle new problems that will appear on continued reflection. All communication from this point needs to be documented: memos from the project leaders, reports from the project workers. Students are working and communicating for a purpose. Their individual effort is needed by others to solve the problem and achieve the common goal.

7) Evaluate the end result. At this point the end result must be compared to the criteria established in step 2, above. If it does not meet the criteria, a

redesigning or rethinking cycle may be initiated. Perhaps other solutions from step 5 might be re-evaluated. If the solution does meet the criteria, can it be easily improved? Does the particular way in which this problem is solved create new problems? Perhaps the original criteria need to be re-evaluated. Necessary changes are made and the final end result is formally presented to the class. This process is capable of generating thoughtful and refined solutions, as well as opportunities for enhancing leadership, communication, presentation, and persuasion skills.

Technology Literacy:

A disturbing trend of 70's and into the 80's, is the delivery of a general education without relating curriculum to the realistic social framework of an increasingly technological world. Students who do not understand the implications of abruptly replacing an industrial worker with a robot, confusing power with license in genetic engineering, or limiting access to computer information as a cause for social stratification, do not understand the ultimate nature of a university education. Through the use of a problem solving strategy, the study of humanities and social science can provide students with an understanding of the problems of our technological society that would otherwise be elusive. We cannot afford to have an undergraduate curriculum which is too often desultory, inconsistent and lacking in rigor as reported in a recent issue of the Chronicle of Higher Education (January 18, 1989).

As the specific problems assigned in a class will support the course content, the manner in which the solutions are achieved can support broader goals related to interpersonal working relationships, communication, and problem solving

skills. The role, then of the educator should be to provide the student with appropriate experiences for defining and solving problems (Cote, 1984).

Summary:

A continuing challenge to universities is to prepare broad-ranging thinkers with the skills to tackle the problems of the future. In this endeavor, we cannot afford to continue to isolate technology from humanity, or we run the danger of the use technology for it's own sake, unrestrained by heritage and careful consideration, or of a society that equates computer prowess to license.

As a curriculum in technology can be improved by relating the core material to social and humanistic value systems, so might a curriculum in the humanities be improved by a focus on the problems and potentials of technology and an increasingly technological society.

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